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(71) Applicant(s)

Crabtree Electrical Industries Limited

(Incorporated in the United Kingdom)

Lincoln Works, Walsall, West Midlands, WS1 2DN,
United Kingdom

(72) Inventor(s)

Henry Charles Horton

(74) Agent and/or Address for Service

Forrester Ketley & Co

Chamberlain House, Paradise Place, BIRMINGHAM,
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(54) Residual current device with reset switch and test circuit

(57) A residual current device comprising live and neutral input 6, 8 and output 10, 12 terminals; a user switch 18; a device trip switch 16 operative between the input and output terminals; and a residual current circuit 24. An electric switch comprises first and second actuating members 20, 36 so located as to constitute a single actuating means 38 which enables both members to be operated simultaneously. First member 20 is associated with the residual current circuit 24 operative to cause the device switch 16 to open on the detection of flow of residual current through the device, and second member 36 is associated with a test circuit 30 comprising a test switch 34. If actuating means 38 is depressed whilst user switch 18 is closed, current flowing through the test circuit 30 will be sensed by the residual current circuit 24; to prevent the device switch 16 from being retained closed, and upon release of the actuating means 38 both of the actuating members 20, 36 will return to their open positions.

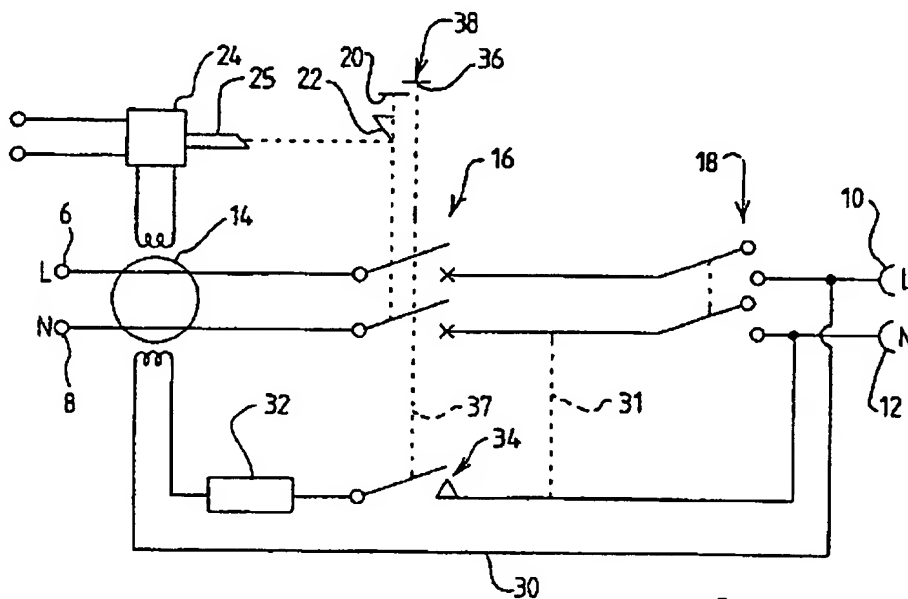
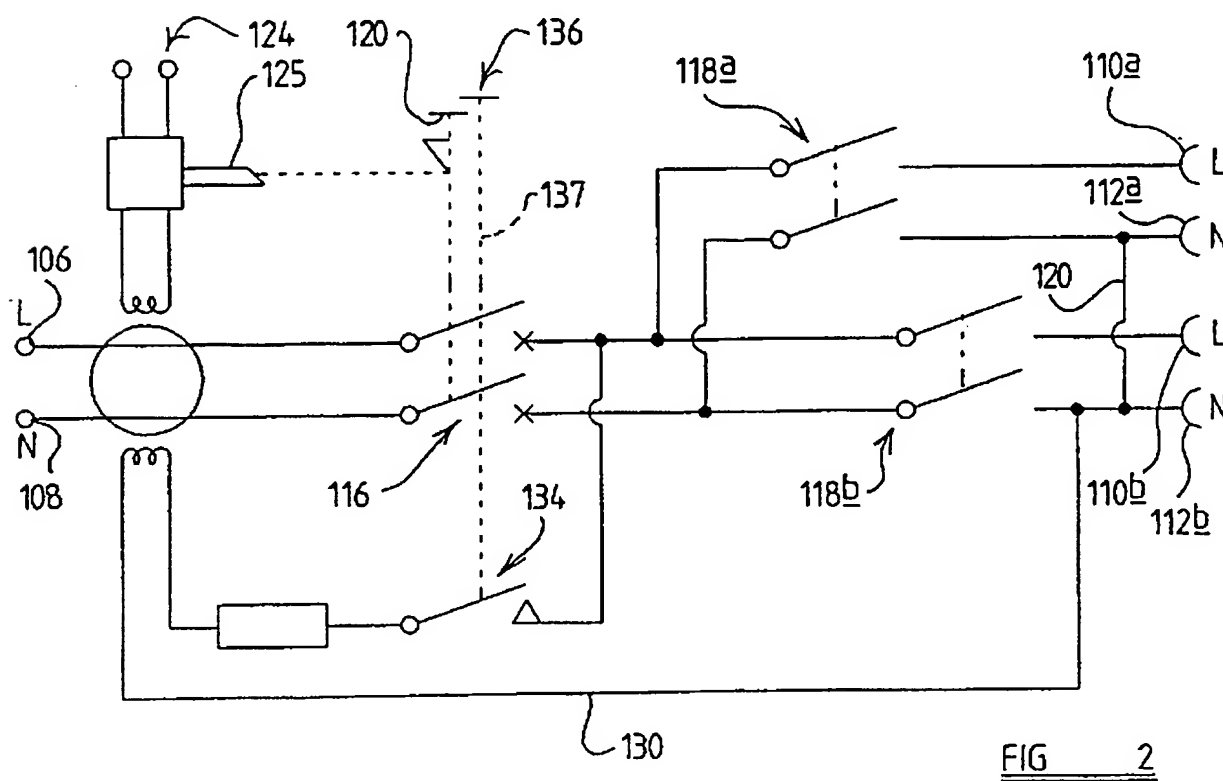
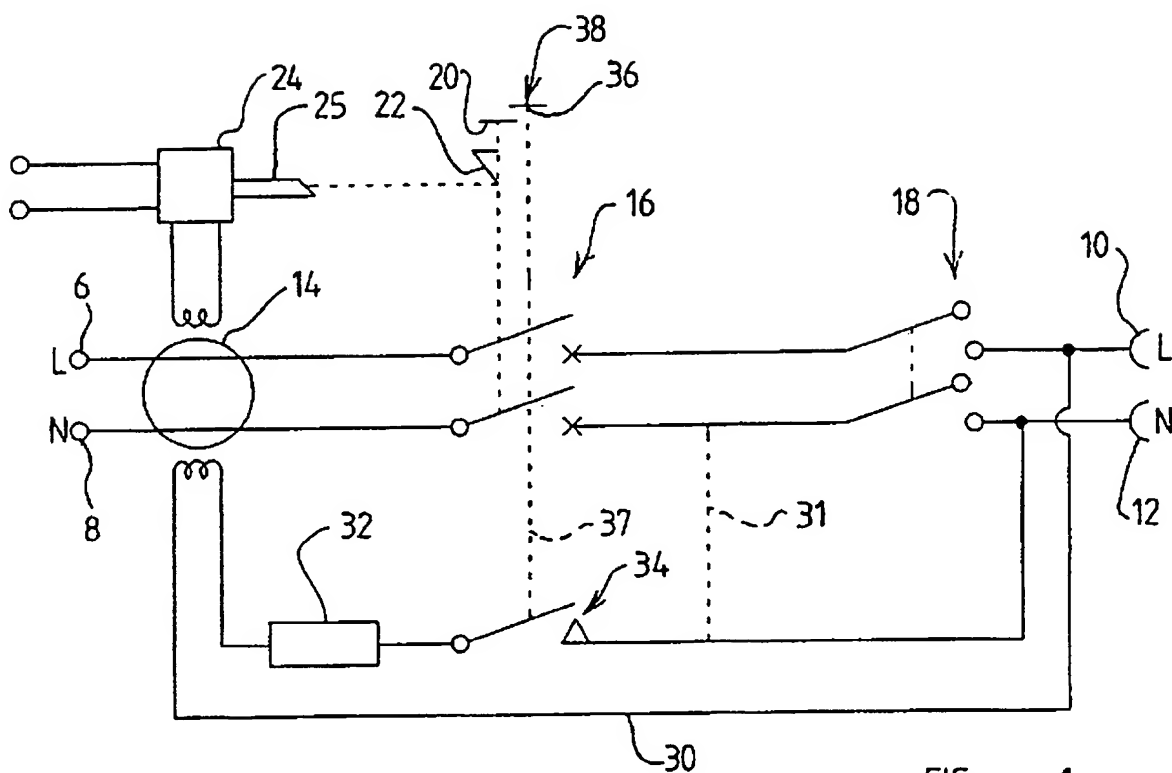


FIG 1

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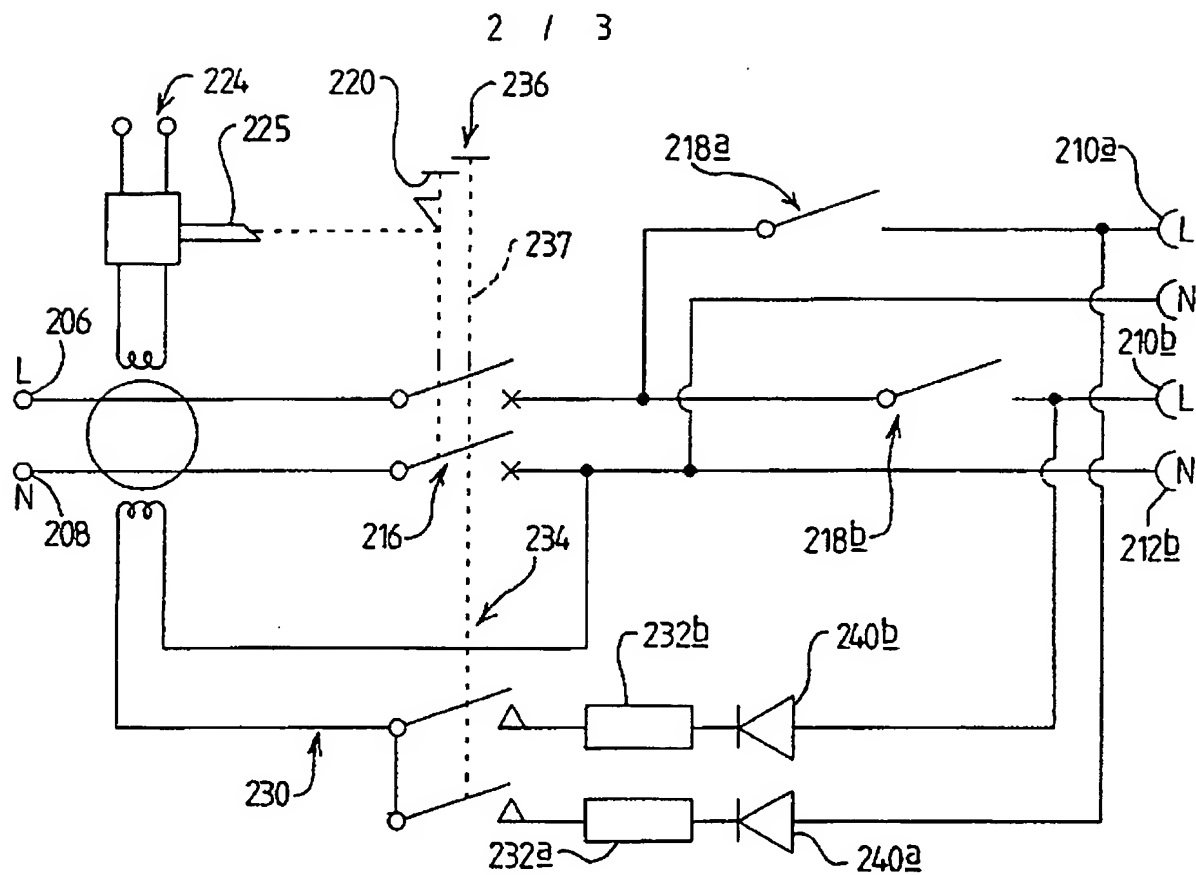


FIG 3

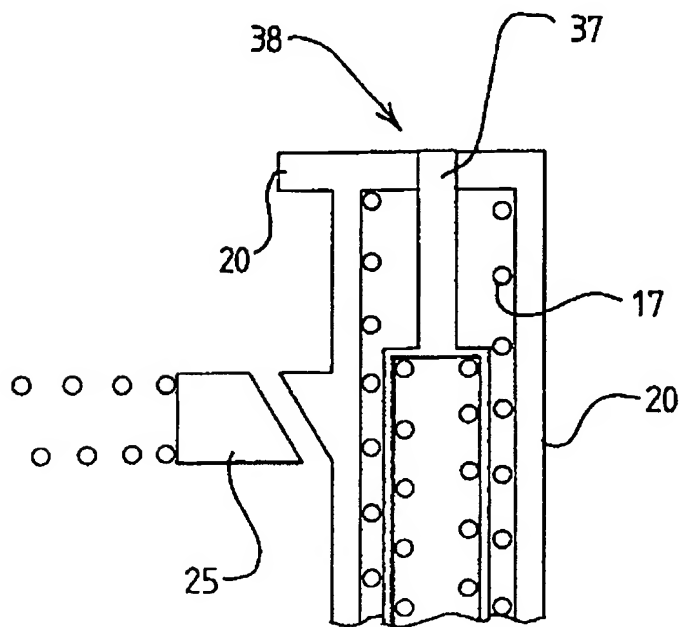


FIG 4a

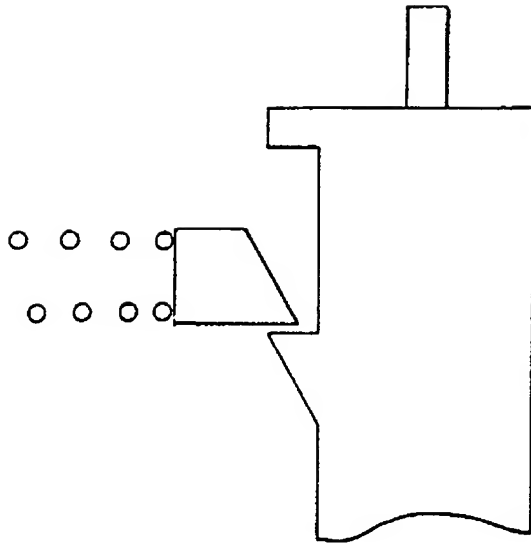


FIG 4b

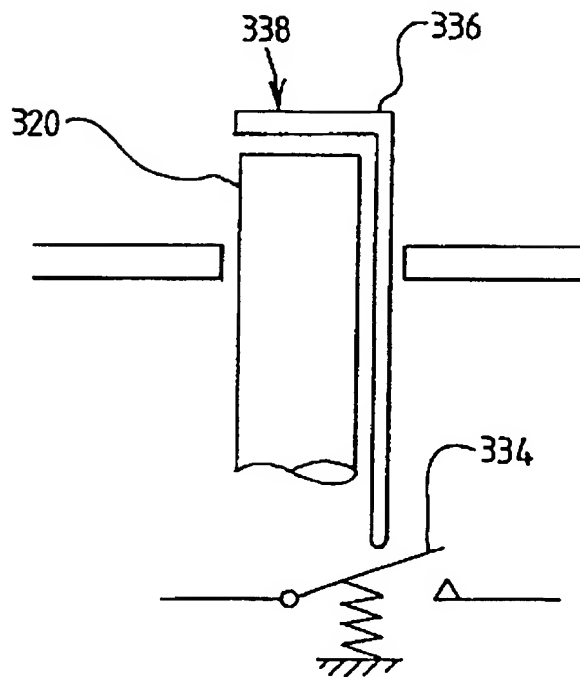


FIG 5

Title: Electric Switches

Description of Invention

This invention is concerned with electric switches, for example residual current devices such as socket outlet RCDs, particularly of the kind (hereinafter referred to as being of the kind specified) comprising

- a) live and neutral input terminals;
- b) live and neutral output terminals;
- c) a user switch associated with the output terminals;
- d) a trip free device switch operative between the input and output terminals; and
- e) a residual current circuit operative to cause the device switch to open on the detection of a flow of residual current through the device.

A conventional socket outlet residual current device comprises an operating member to reset the device switch when the circuit has been tripped, and a separate actuating member, which is conventionally a momentary-closing device, to close a test circuit to enable the user to test that the device is functioning properly. Conventionally when the test switch is pressed, the test circuit simulates a current imbalance, causing the device switch to be tripped.

One of the difficulties encountered in residual current devices of this type is that the speed of closing of the device switch contacts is directly influenced by the operator. This can result in severe erosion or contact welding if the contacts are slowly closed onto a high current load or onto a fault.

According to this invention there is provided a residual current device of the kind specified, characterised in that resetting of the device switch is effected whilst the test circuit is closed.

Thus should resetting of the device switch be attempted whilst the user switch is closed, the test circuit will operate to trip the device switch, thereby preventing the device switch to be latched whilst the user switch is closed.

The device may comprise actuating means operable readily to enable the device switch and the test switch to be closed simultaneously. Thus, a single actuating member may be provided connected to both the device switch and the test switch, or the actuating means may comprise separate actuating members in close proximity such that they may be actuated by a finger of a user.

Thus two actuating members may be provided which are mounted side by side, or coaxially mounted.

Preferably the actuating member for the test switch is a monostable, or "pop-up" switch.

According to this invention there is also provided a residual current device of the kind specified, characterised in that the device comprises a test circuit comprising a test switch connected in such a way that, on simultaneous depression of the test switch and the device switch with the user switch closed, current flowing through the test circuit is sensed by the residual current circuit to prevent the device switch from remaining closed.

Conveniently the test circuit is connected to the live and neutral terminals between the user switch and the output terminals, but one of said connections (e.g. to the neutral line) may be made between the user switch and the device switch.

The invention is of great advantage where the device comprises two user switches each comprising live and neutral output terminals. In such circumstances preferably the test circuit is connected to one of said live and neutral lines between one of the user switches and the device switch and is connected to the other of said live and neutral lines between other of the user switches and the output terminals.

Preferably the circuit is connected to said neutral line downstream of the device switch, and preferably said neutral lines are bridged downstream of the user switch.

In this manner should the device and test switches be closed simultaneously with either of the user switches closed, flow of current through the

test circuit will be detected by the residual current circuit to prevent the device switch from being latched in a closed position.

Alternatively where the user switch is not operative across the neutral lines, the test circuit may be connected to the live lines downstream of the user switches, preferably diode means being provided to prevent the flow of current between the two live lines when the test switch is closed.

Thus on operation of the actuating means by a single finger, both the device switch and the test switch will be closed, and in the event of one or both of the user switches being closed, current will pass through the test circuit in response to which the residual current circuit will cause the trip free device contacts to open, the instant they start to pass current. On releasing the actuating members, both will be returned to their open positions. If an earth fault is present, the fault current will augment the test current but will not alter the operation of the device.

Conversely, in the event that both user switches are open, both the test circuit and the external load circuit are isolated, the device switch may be latched in its closed position, and the actuating member for the test switch will return to its open position.

When in the normal use of the residual current device out of balance current is detected by the residual current circuit, the device switch is de-latched, moving to its open position.

Preferably the device switch is bipolar, and preferably the or each user switch is bi-polar.

According to this invention there is also provided an electric switch comprising a first actuating member for closing a first circuit and a second actuating member to closing a second circuit, the two actuating members being so located as to constitute a single actuating means which enables both actuating members to be operated simultaneously to close their respective circuits.

Preferably the actuating members are so arranged that a visual indication is provided when one circuit is open and the other circuit is closed.

The actuating members may be mounted side by side, or may be coaxially mounted.

A switch of the kind set out in the last preceding paragraph is particularly suitable for use in a residual current device such as a socket outlet RCD, wherein the first circuit is a trip-free circuit operative between the input and output terminals of the device, and the second circuit is a test circuit of the RCD.

There will now be given a detailed description, to be read with reference to the accompanying drawings, of three circuits which are preferred embodiments of this invention, having been selected for the purposes of illustrating the invention by way of example.

In the accompanying drawings:

Figure 1 is a view of a circuit of a residual current device which is the first embodiment of this invention;

Figure 2 is a circuit of a residual current device which is the second embodiment of this invention;

Figure 3 is circuit of a residual current device which is the third embodiment of this invention;

Figure 4a is a schematic sectional view showing actuating means for use in either of the two devices, the actuating means being in a tripped condition;

Figure 4b is a view corresponding to Figure 4a showing the actuating means in a latched condition; and

Figure 5 is a schematic sectional view of an alternative actuating means.

The device which is the first embodiment of this invention comprises a supply side comprising live and neutral input terminals 6, 8, and an output side comprising live and neutral output terminals 10, 12.

The input terminals 6 and 8 are connected to a bipolar trip free device switch 16 by way of an inductance device 14, in the form of a toroid of which the live and neutral lines provide primary windings, the device switch 16 being

connected to a bi-polar switch 18 located between the device switch 16 and the output terminals 10, 12. The device switch 16 is biased by spring force into a normally open condition (upwardly in Figure 1).

The device comprises an actuating member 20 for the device switch (shown schematically in Figure 1) comprising a latch 22, by which the actuating member 20 when depressed may cause the device switch 16 to be closed, and retained closed in latched condition. In conventional manner the device comprises a residual current circuit 24 connected to the toroid 14 as a secondary winding, to sense the flow of out of balance current through the device, and which is arranged such that by way of some electromechanical or other linkage, in the event of the circuit 24 sensing out of balance current, the device switch 16 opens.

In the preferred embodiment a finger 25 is urged into a forward, latching position by a spring (not shown) and which is retracted by a solenoid when current flows through the residual current circuit 24. A leading end of the finger 25 is chamfered, causing the finger to be momentarily retracted behind the latch 22 on depression of the actuating member 20.

The device which is the first embodiment of this invention comprises a test circuit 30, similarly connected to the toroid 14 as a tertiary winding, and comprising a test resistor 32, and a test switch 34 connected to the output side of the supply circuit. In particular, the test circuit is connected to the live and neutral lines between the user switch 18 and the output terminals 10, 12 respectively, although if desired one of said connections (e.g. to the neutral line) may be upstream of the user switch 18, as shown by the broken line 31.

The test switch 34 is adapted to be closed by an actuating member 36, conveniently of "retractive" construction such that the test switch 34 cannot be latched closed, but returns to its open condition immediately after being released.

In the preferred embodiment the two actuating members 20, 36 constitute a single actuating means 38 adapted to be operated by the user simultaneously, such as by locating of the two actuating members side by side, or more conveniently coaxially, as is shown in Figure 4. In this manner, when the

actuating means 38 is depressed, both the device switch 16 and the test switch 34 are closed simultaneously.

In the event of the actuating means 38 being depressed whilst the user switch 18 is closed, current flowing through the test circuit will be sensed by the residual current circuit, the retractable finger 25 is withdrawn which will prevent the switch 16 from being latched, and both actuating members 20 and 36 will return to their "up" or open positions. In this manner the device is prevented from being latched closed onto a circuit fault.

In the event of depression of the actuating means 38 with the user switch 18 open, the actuating member 20 may be latched in its closed position to close the device switch whilst the actuating member 36 will "pop-up" as shown in Figure 4b subsequent to momentary closing of the test switch 34.

Conversely when the actuating member is latched closed, the actuating member 36 may be depressed to test the circuit, provided that the user switch 18 is closed.

Preferably the actuating member 20 is rigidly connected to the moving contacts of the device switch 16 such that the position of the actuating member reliably indicates the position of the device switch contacts.

In this manner a visual indication is provided which indicates that the device switch is closed, by virtue of the actuating member 36 being visible at a distance from that of the actuating member 20. For example, as shown in Figure 4a, preferably the two actuating members are mounted coaxially, with a part 37 of the actuating member 36 being capable of protruding upwardly through a central aperture in the actuating member 20. By the use of appropriate colouring, the state of the actuating member 20 may be made visually apparent, since when the latch has been tripped the part 37 will be approximately level with the top of the actuating member 20, whilst if the part 27 protrudes through the actuating member 20, as shown in Figure 4b, this will indicate that the device switch is latched closed.

The device which is the second embodiment of this invention, shown in Figure 2, is similar to the first embodiment, and will be described hereinafter primarily insofar as it differs from the first embodiment. Similar numerals increased by 100 are used to indicate parts similar to those of the first embodiment.

In the second embodiment a twin socket output is utilised, each socket output comprising a switch 118_a, 118_b and a pair of live and neutral terminals 110_a, 112_a, 110_b, 112_b. As with the first embodiment, each of the user switches 118 is double pole, and the test circuit 130 is connected to the live line between the device switch 116 and the user switches 118, being connected to the neutral line between the user switch 118_b and the neutral output terminal 112_b, a bridge 120 being provided between the two neutral output terminals 112_a and 112_b.

In this manner if whilst the actuating means 136 is depressed either of the user switches 118_a or 118_b is closed, current will flow through the test circuit 130 which will be sensed by the RCD circuit 124 preventing the switch 116 from being latched closed.

The device which is the third embodiment of the invention, shown in Figure 3, is similar to the second embodiment and will be described hereinafter primarily insofar as it differs from the second embodiment. Similar numerals increased by a further one hundred are used to indicate parts similar to those of the second embodiment.

In the third embodiment the neutral lines are "hard wired" - that is, the two switches of the twin socket output are not operative across the neutral lines.

The test circuit 230 is connected to the live lines 210_a, 210_b, diodes 240_a, 240_b being incorporated into the circuit to prevent current from flowing from one of the live lines to the other.

In this embodiment the test current is determined by two test resistors, 232_a and 232_b. These are chosen to be of resistance value such that when either or both of the user switches 218_a and 218_b are closed, the total combined test

current which flows through the test circuit 230 remains within the permissible range. The two test resistors are preferably of equal resistance value.

By dividing the test resistance between two resistors in this manner it is possible to limit the prospective current which could flow from one line to the other in the event of the failure of one of the diodes 240_a or 240_b, to half of the maximum test current.

Whilst in the preferred embodiments the invention has been described as applied to residual current devices, an aspect of the invention may be used to advantage in certain circumstances where it is desired to provide control over two circuits, particularly where one circuit may not be closed whilst another circuit remains open.

Thus the actuating means shown in Figure 3 may be utilised in a circuit, wherein the first actuating member 20 operates to open and close a first circuit and the second actuating member 36 operates to open and close a second circuit.

With the two actuating members 20 and 36 in the relative position shown in Figure 4b, with the part 37 of the actuating member 36 protruding through the aperture of the actuating member 20, ^{it}~~this~~ may be seen that the device switch is latched closed, and the test switch, constituted by the actuating member 36, may be depressed to check that the circuit breaking function of the device is functioning correctly, such operation causing the device to trip in the conventional manner.

With the two actuating members in the relative position shown in Figure 4a, both may be depressed simultaneously by the finger of a user, causing the test circuit to close conveniently momentarily before the device switch is closed, to prevent the device switch from being latched closed should the user switch, or one of these switches if there is more than one, be closed, preventing the device from being reset onto a fault.

In the view shown in Figure 5, in which similar numerals increased by a further one hundred are utilised, an alternative construction of common

actuating means 238 is shown, enabling re-setting and testing to be accomplished easily.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. A residual current device comprising
 - a) live and neutral input terminals;
 - b) live and neutral output terminals;
 - c) a user switch associated with the output terminals;
 - d) a trip free device switch operative between the input and output terminals; and
 - e) a residual current circuit operative to cause the device switch to open on the detection of a flow of residual current through the device;characterised in that resetting of the device switch is effected whilst the test circuit is closed.
2. A residual current device according to Claim 1 comprising actuating means operable readily to enable the device switch and the test switch to be closed simultaneously.
3. A residual current device according to Claim 3 comprising a single actuating member connected to both the device switch and the test switch.
4. A residual current device according to Claim 3 wherein the actuating means comprises separate actuating members in close proximity such that they may be actuated by a finger of a user.
5. A residual current device according to Claim 4 wherein the actuating members are mounted side by side.
6. A residual current device according to Claim 4 wherein the actuating members are coaxially mounted.

7. A residual current device according to any one of Claims 4 to 6 wherein the actuating member for the test switch is monostable.
8. A residual current device of the kind specified, characterised by the provision of a test circuit comprising a test switch connected in such a way that, on simultaneous depression of the test switch and the device switch with the user switch closed, current flowing through the test circuit is sensed by the residual current circuit to prevent the device switch from remaining closed.
9. A residual current device according to Claim 8 wherein the test circuit is connected to the live terminal between the user switch and the live output terminal.
10. A residual current device according to one of Claims 8 and 9 wherein the test circuit is connected to the neutral terminal between the user switch and the device switch.
11. A residual current device according to any one of Claims 8 to 10 wherein the device comprises two user switches each comprising live and neutral output terminals.
12. A residual current device according to Claim 11 wherein the test circuit is connected to one of said live and neutral lines between one of the user switches and the device switch and is connected to the other of said live and neutral lines between the other of the user switches and the output terminals.
13. A residual current device according to Claim 12 wherein the circuit is connected to the neutral line downstream of the device switch.

14. A residual current device according to Claim 13 wherein the neutral lines are bridged downstream of the device switch.

15. A residual current device according to any one of the preceding claims wherein the device switch is bi-polar, and preferably the or each user switch is bi-polar.

16. An electric switch comprising a first actuating member for closing a first circuit and a second actuating member for closing a second circuit, the two actuating members being so located as to constitute a single actuating means which enables both actuating members to be operated simultaneously to close their respective circuits.

17. An electric switch according to Claim 16 wherein the actuating members are so arranged that a visual indication is provided when one circuit is open and the other circuit is closed.

18. An electric switch according to one of Claims 16 and 17 wherein the two actuating members are mounted side by side.

19. An electric switch according to one of Claims 16 and 17 wherein the two actuating members are coaxially mounted.

20. An electric switch according to any one of Claims 16 to 19, the switch affording part of a residual current device.

21. An electric switch according to Claim 20 wherein the first circuit is a residual current circuit operative to cause a device switch of the residual current device to open on the detection of a flow of residual current through the device, and the second circuit is a test circuit.

22. A residual current device constructed and arranged substantially as hereinbefore described with reference to any of the accompanying drawings.

23. An electric switch constructed and arranged substantially as hereinbefore described with reference to any of the accompanying drawings.

24. Any novel feature or novel combination of features hereinbefore described and/or shown in the accompanying drawings.



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Claims searched: 1-15, 22

Examiner: Mr Conal Oram
Date of search: 3 November 1995

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): H2K (KFA, KHH)

Int Cl (Ed.6): H02H (3/33, 3/347)

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2204198 A (QUALCAST) page 4 line 35 - page 5 line 34	1 at least
X	US 4825329 (TURNER) figures 5A-5H	1 at least

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
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